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ON THE MICROSCOPIC AND GENERAL CHARACTERS OF THE PEACH TREE AFFECTED WITH THE "YELLOWWS."

BY W. K. HIGLEY.

SYMPTOMS OF THE YELLOWWS.

1. *Premature Ripening.*—This symptom is one of the most common, although it is not by any means always noticed. In many cases it is very marked. During my investigation I have corresponded freely with persons upon this subject, and many have stated that this is only a marked symptom in certain varieties, prominent among which is "Stanlie's late." Mr. John Williams, of South Haven, sent me specimens of this variety that ripened three weeks before the proper time. This symptom is not wholly confined to the peach affected with the yellows, as it is also said to be produced by the borer and curculio, but from all the evidence that I have been able to glean, I think that it can be safely stated that it is an infallible symptom when noticed in some localities. I cannot agree with those who state that this symptom is only noticed in certain varieties, but think that although it may not always happen, yet when it does it is just as liable to be on one variety as another. It is, at all events, a thing to be looked after when the presence of this disease is feared.

2. *Color of the Peach.*—I have noticed particularly that affected peaches, when opened, presented a very abnormal appearance as to the position, extent and size of the pigment spots. In the normal fruit bright red spots are often present near the pit and, perhaps, even toward the outer portions of the cellular part,

while in the diseased fruit, especially that which has prematurely ripened, near the pit considerable red coloring matter may be noticed, often in a conglomerate mass, and scattered through the remainder of the fleshy portions many oblong or rounded masses of the same color. Under the microscope these appear to be simply cells filled with a coloring matter that may be removed by treating with strong potassic hydrate, acetic acid, or alcohol. The skin of the peach also shows a highly abnormal color, generally simply spotted with red, but in some specimens that I have had the opportunity of examining, this red color assumed an oblong shape, the spots being arranged in bands. This symptom seems to be of the highest importance, as there is no other disease, so far as I am able to ascertain, that will produce the above results.

3. *Production of Abnormal Branches.*—Perhaps one of the most marked symptoms of the yellows is the abnormal production of branches, or rather branchlets. But the pomologist must guard against one important fact in diagnosing the yellows from this symptom, viz., *the production of numerous twigs*. Non-cultivation of any domesticated tree will often cause a great abundance of small twigs or shoots to grow from the secondary branches; they may continue as high as the sixth division into branches. Again a great proficiency of twigs may be produced by the use of much rich manure year after year. However, to return to the discussion of branchlets as an indication of the yellows, let it be remembered that it is the branchlets and not the twigs that are of importance. These are produced on the main or larger branches from lateral buds, and in some cases even from the trunk of the tree. They are slender wire-like shoots, often no larger than a needle, from two to eight inches long, and not seldom showing a tendency to throw out lateral or secondary shoots. They may attain to a much greater length, but, as far as I can ascertain, the above measurements form a good average. This peculiar feature of the disease is easily explained. A spore of the fungus falling upon some part of the branch, finds the conditions favorable for development and sends out its mycelium which ramifies through the tissues of the limb and soon fills up the passages, crowding the vessels and cells so that the flow of sap to the parts beyond this point is nearly stopped; thus the ends of the growing branches being choked, the sap is caused to flow to the lateral buds, and these having so plentiful a supply of nutriment, grow

rapidly and throw out these wire-like shoots. This symptom, with the one previous, are sure and infallible guides to the detection of the yellows; they often occur together, but more often the former is the second stage, only appearing after the latter has been present the year previous. I examined carefully several specimens of these branchlets, and in two-thirds of them I found the mycelium of a fungus in the tissue. Those in which the fungus was present were from South Haven, the remainder from other localities showed no signs of mycelial growth. It is very probable, however, had time permitted extended sectional examinations, that I should have found, even in these, evidences of parasitical forms.

4. *Microscopical Symptoms.*—There are many marked peculiarities noticed when sections of the different parts of a tree are studied, but whether or not some of these will be produced by other causes than the yellows, is a subject too patent to need any discussion. One of the most important points noticed in microscopical examination, is the *loose character of the cells* and other parts of the section, both transverse and longitudinal. This would only be noticed by one who has carefully compared both sections of the healthy and unhealthy tree. I was very much surprised when I first noticed this condition of things, and hoping that it might give me some clue to the cause of the disease, I examined several more specimens, but with no important results, except that it was a constant character of the diseased specimens that I had; it appeared in sections of the root as well as in those of the aerial portions. Attention may be called also to the sheets of mycelia that are sometimes found between the layers of wood as probably another symptom. Some of the many investigators who attribute the yellows to a fungoid growth, consider this as very marked evidence of the yellows, but it is not near so marked as is the abnormal coloring matter noticed in the pith. In the specimens of the wood of diseased trees that I have been permitted to examine, the most prominent microscopical symptom was the decided separation of the annual growths of wood; in the space thus formed no structure was visible, although apparently filled with some material, perhaps the ends of mycelia. I found it quite difficult to make sections of the diseased limbs and other parts of the aerial portions of diseased trees, for, on account of this loose structure, the cells, especially of the bark, were

easily displaced, thus showing that one effect of the disease is a tendency toward *disorganization*. How far this character may extend, I am unable to say, but it was very marked in all the specimens sent me. I was unable to make thin sections for study until the parts were soaked in strong alcohol or chromate solution for some time. I am informed that a gentleman, whose name I am not able to obtain, claims that in nearly all the sections of diseased specimens that he examined, he noticed that a great number of the cells of the pith and inner bark and many of those of the woody portions were ruptured and completely disorganized. Although I have examined a number of sections, looking carefully in each for ruptured cells, I have not been able to find any. Therefore I can only give the above statement on authority not being able to sanction it by my own work. I have no doubt that some one or more very important microscopical symptoms may be found, on the comparison of more specimens from many localities, that are not enumerated above.

5. *Appearance of the unmagnified Section*.—A section of the trunk of a tree, well along in years, shows peculiarities to a marked degree. One first notices the yellowish color which pervades the whole section, with the rings marking the annual growths of a darker color, perhaps a light brown, and then the dark spots scattered through the woody portion. It very forcibly reminds one of a bilious state of the system. A section of the root presented nothing abnormal to the naked eye.

6. *Appearance of the Leaves*.—The leaves upon the diseased branches have a general sickly appearance, are of a pale color and more or less dried. Especially are the leaves of the abnormal shoots or branchlets characteristic; these are pale and often more or less curled. There seems to be a greater number of leaves than is normal, upon diseased trees, especially before it has lost the greater part of its vitality. This is not to be wondered at, as the leaves are really the lungs of the tree, the green matter acting the part of an absorbent. If now several of the branches become diseased and the leaves lose their power to act, it seems natural that in order to obtain that nutriment necessary for vitality, assigned to the leaves, more leaves would be formed upon the healthy portions of the tree. Soon there has been so much of the nutriment of the tree used to overcome this gasping caused by the diseased branches, whose trouble is steadily advancing to

other branches, that but little is left to form the fruit, and thus the peaches grow smaller and fewer in numbers after the first premature ripening until the tree dies!

As so many other causes, as a direct effect, produce a diseased condition of the leaves, they can hardly be accepted as a true symptom of the yellows, unless in connection with other marked indications.

Perhaps I have said more upon the symptoms of the yellows than many would consider necessary, but it is well known that the physician diagnoses a disease from the symptoms, and then looks for that which will produce the cure. In plain words, the indications give him a clue to the cause and what will afterwards be essential for the cure. To this end I desire to call forth from the *practical and scientific fruit growers* a report of what they have noticed, whenever it has been their privilege to observe the symptoms and action of this disease, hoping that I may glean from these reports something that may guide us in our work.

Nearly every species of parasitical fungi has its special host, often carrying this so far as to refuse to grow upon a closely-allied species or variety. Many others will grow upon allied hosts provided the true host is removed. But this does not seem to be the case with the fungus that we are dealing with at present; it is characteristic of the peach alone. Hill's Chili seems to suffer the most, but still it clings to other varieties just as tenaciously when once introduced into an orchard. There is no doubt but that we can safely say "*no variety is exempt.*"

SOIL AND PREVENTIVES.

Does the soil have any effect upon the yellows? In answer to this question, I should say, *directly no; but indirectly it does.*

I am quite positive that if the orchard is kept in the proper state of cultivation it will not be as apt to contract the disease, although I cannot say that this is a preventive in the face of all the evidence to the contrary. It is a well known fact, however, that if the digestive, circulatory and respiratory organs in man are in their proper state, there is not near as much danger of the body contracting a disease. I believe that this is, to a great extent, also characteristic of the vegetable kingdom. Thus the right food and care, or in plain words the right cultivation, fertilization and pruning, may, to a great extent, aid the pomologist in his

warfare against the yellows. On the other hand, lack of care in cultivation, etc., may reduce the tree to such a condition that it becomes susceptible to disease, and is more liable than in the first case to catch this troublesome malady.

Downing says,¹ "Let us look for a moment into the history of the peach culture in the United States. For almost an hundred years after this tree was introduced into this country, it was largely cultivated, especially in Virginia, Maryland and New Jersey, as we have already stated, in perfect freedom from such disease [the yellows], and with the least possible care. The great natural fertility of the soil was unexhausted, and the land occupied by orchards was seldom or never cropped. Most of the soil of the States, however, though at first naturally rich, was light and sandy, and in course of time became comparatively exhausted. The peach tree, always productive to an excess in this climate, in the impoverished soil was no longer able to recruit its energies by annual growth, and gradually became more and more enfeebled and short lived."

I have great regard for the opinion of practical experimenters and investigators—the horticulturists of our country—but looking at the matter from a scientific standpoint, I must confess that I firmly believe that if great care be exercised in cultivation, pruning, etc., the fruit grower will be greatly aided in reducing the spread of this disease.

I can but agree with Professor Kedzie when he says, "I think the trees lack potash and phosphoric acid." These may be applied in cultivation by mixing them, either separately or combined, with the earth around the base of the tree where they can be absorbed by the roots; or superphosphate of lime and ashes may be used.

The subjects of cultivation and the preservation of the trees and the prevention of this disease by this means, belong rather to the practical investigator than to the microscopist or chemist, for we, working with our microscope and test-tube, can only suggest and theorize, while the experiments must be left with those who raise the trees. In concluding these remarks, I am glad to be able to say that many are carefully experimenting and noting their observations and results.

¹ "Fruits and Fruit Trees of America," eighth edition, p. 464.

HISTORY.

A few of the statements made above led me at this point to consider the history of this disease.

It is one of the oldest tree diseases on record in this country. It seems to have first appeared in the Atlantic States, or near that region. It does not seem to have been imported, as there is no record, as far as I can ascertain, of its ever occurring in the old world before its presence was detected here; and, moreover, the only note that I have noticed of its presence in Europe, stated that it was brought from this country in the pits, and the trees raised from them showed symptoms of the yellows and soon died.

"About 1800, or a few years before, attention was attracted in the neighborhood of Philadelphia to the sudden decay and death of orchards without apparent cause. From Philadelphia and Delaware the disease gradually extended to New-Jersey, where, in 1844, it was so prevalent as to destroy a considerable part of all the orchards. About three or four years later it appeared on the banks of the Hudson (or from 1812 to 1815), gradually and slowly extending northward and westward, to the remainder of the State. Its progress to Connecticut was taking place at the same time, a few trees here and there showing the disease until it became well known (though not yet generally prevalent) throughout most of the warmer parts of New England."¹

Downing continues with many remarks confirming further what has been said under the action of the soil and preventives. For this reason I shall quote still further from his work:²

"It should be here remarked that, though the disease had been considerably noticed in Maryland and Middle States previously, yet it was by no means general until about the close of the last war. At this time wheat and other grain crops bore very high prices, and the failing fertility of the peach orchard soils of those States was suddenly still more lowered by a heavy system of cropping between the trees, without returning anything to the soil. Still the peach was planted, produced a few heavy crops, and declined, from sheer feebleness and want of sustenance. As it was the custom with many orchardists to raise their own seedling trees, and as almost all nurserymen gathered the stones *indiscriminately* for stocks, it is evident that the constitutional debility of the parent tree would naturally be inherited to a greater or less degree by the seedlings. Still the system of allowing the tree to exhaust itself by heavy and repeated crops in

¹ "Fruit and Fruit Trees of America," p. 464.

² Page 464.

a light soil was adhered to, and generation after generation of seedlings, each more enfeebled than the former, at last produced a completely sickly and feeble stock of peach trees in those districts.

"The great abundance of this fruit caused it to find its way, more or less into all the markets on the sea-coast. The stones of the enfeebled southern trees were thus carried north, and, being esteemed by many better than those of home growth, were everywhere more or less planted. They brought with them the enfeebled and tainted constitution derived from the parent stock. They reproduced almost always the same disease in the new soil and thus, little by little, the yellows spread from its original neighborhood, below Philadelphia, to the whole northern and eastern sections of the Union. At this moment it is slowly but gradually moving west, though the rich and deep soils of the western alluvial bottoms will, perhaps, for a considerable time, even without care, overpower the original taint of the trees and stones received from the east."

As to the appearance of the yellows in New Jersey, I will quote again:¹

"A gentleman to the peach 'manor born,'—in Monmouth county, N. J.—but who has resided in this vicinity during the past ten years, informs us that he has witnessed the destruction of the peach orchards in these localities during the past thirty years. First in Monmouth county, about 1850, the yellows made its appearance, and culminated in the destruction of the peach orchards about 1856. Monmouth county and vicinity were famous in their day, having often glutted the eastern markets with peaches. Driven from the Atlantic coast counties by the yellows, the prominent peach growers of New Jersey located in Morris and other counties in the north of the State, where peaches were grown successfully until about 1867, when New Jersey peach growers were again driven by the yellows to 'fresh fields,' favorable localities in Delaware and Maryland being chosen, from whence the eastern markets have received their principal supplies during the past few years. Incipient signs of yellows have appeared in Delaware and Maryland, and it is evident that a 'change of base' will soon become necessary."

In the same volume it says: "The first record of the peach yellows is found in the *Genesee Farmer*, and was published about forty-five years ago. The disease as it now exists was accurately described. The Farmers' Book, which was compiled and printed at Chambersburgh, Penn., Sept. 16, 1845, contains a communication from Sidney Weller, Halifax county, North Carolina." So

¹ Michigan Pomological Report, 1878, p. 256.

it seems that previous to 1845 it had been detected in North Carolina.

The disease appeared in Michigan about 1857; the exact time is not known, nor by what method it was introduced. To my knowledge it has not been reported in Ohio or Indiana. If this be true it is a query how it got to Michigan unless imported in the fruit or young trees brought from nurseries in infected districts. This I believe to be the case, and have a faint recollection of seeing a published statement to that effect.

The orchards of the South Haven district seem to have been the first to suffer.

From the above facts of history, it will be seen that this disease is one that progresses slowly, and yet in one sense rapidly, and is as sure in its results as is pulmonary consumption. It is to be hoped that such active measures shall be taken that its future history shall not cover near as much territory as at the present time. It is a disease that, unless checked in its progress, will follow wherever civilization advances.

[*To be continued.*]

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ON THE SO-CALLED CHUKCHI AND NAMOLLO PEOPLE OF EASTERN SIBERIA.¹

BY W. H. DALL.

THE natives of that portion of Asia lying east of the meridian of 180° from Greenwich, and between Behring sea and strait and the Arctic ocean, have always been regarded with particular interest. This interest arises partly from the fact that they alone of all the Siberian tribes have maintained their independence of Russian authority, and partly from the idea that these people form a link between the races of Asia and America; a thorough knowledge of their ethnological position being supposed to be all that was required to confirm or disprove certain theories of migration.

Another source of interest is the confusion that has always existed in regard to their division into different stocks, and which is still far from being cleared away. The forthcoming work of Lieut. Nordqvist, of the *Vega* Expedition, will doubtless afford

¹ Read before the American Association for the Advancement of Science, Cincinnati, 1881.